SECTION III. DOSE ASSESSMENT

61.94(b)(7): Description of Dose Calculations

Effective dose equivalent (or dose) calculations for point sources, unsampled point sources, and nonpoint gaseous activation products from LANSCE and TA-18 were performed with the mainframe CAP88 version of AIRDOS. This procedure included using PREPAR to prepare the input file to AIRDOS and using the DARTAB preprocessor to prepare the dose conversion factor input file for DARTAB. The calculations used dose conversion factors taken from the RADRISK database that was distributed along with the CAP88 programs.[7] Verification of the CAP88 code was performed regularly by running the EPA test cases originally distributed with the mainframe version.[8]

Development of Source Term

Tritium Emissions

Tritium emissions from the Laboratory's tritium facilities are measured using a collection device known as a bubbler. This device enables the Laboratory to determine not only the total amount of tritium released but also whether it is in the elemental (HT) or oxide (HTO) form. The bubbler operates by pulling a continuous sample of air from the stack, which is then "bubbled" through three sequential vials containing ethylene glycol. The ethylene glycol collects the water vapor from the sample of air, including any tritium that is part of a water molecule (tritium oxide or HTO). After "bubbling" through these three vials, essentially all HTO is removed from the air, leaving elemental tritium or HT. The sample, containing the elemental tritium, is then passed through a palladium catalyst that converts the elemental tritium to HTO. The sample is pulled through three additional vials containing ethylene glycol, which collects the newly formed HTO. The amount of HTO and HT is determined by analyzing the ethylene glycol for the presence of tritium using liquid scintillation counting (LSC). Although LANL's measurement device can distinguish the presence of HTO from HT, all emissions of tritium are assumed to be HTO for modeling the off-site dose. Because HTO contributes approximately 20,000 times more dose than an equivalent amount of HT, this is a conservative measure that further ensures that the dose to an off-site receptor is not underestimated.

Tritium emissions from LANSCE (which do not require monitoring under 40 CFR 61.93(b)(4)(i)) are determined using a silica gel sampler. A sample of stack air is suctioned through a cartridge containing silica gel. The silica gel collects the water vapor from the air, including any HTO. The water is distilled from the sample, and the amount of HTO is determined by analyzing the water using LSC. Because the primary source for tritium at LANSCE is activated water, sampling for only HTO is appropriate. These results are also corrected using the absolute humidity measured in the stack.

Radioactive Particle Emissions

Emissions of radioactive particulate matter, generated by operations at facilities such as the Chemistry and Metallurgy Research (CMR) Building and TA-55, are sampled using a glass-fiber filter. A continuous sample of stack air is suctioned through the filter, where small particles of radioactive material are captured. These samples are analyzed weekly using gross

alpha/beta counting and gamma spectroscopy to identify any increase in emissions and to identify short-lived radioactive materials. Every six months, LANL combines these samples for subsequent analysis at an off-site Laboratory. These composite samples are analyzed to determine the total activity of materials such as uranium-234/235/238, plutonium-238/239/240, and americium-241. These data are then combined with estimates of sampling losses and stack and sample flows to calculate emissions. For the case of radionuclides that have short-lived daughters, LANL includes these progeny in the source term. For example, the analytical laboratory measures the parent radionuclide uranium-238, and its short-lived progeny (thorium-234 and protactinium-234m) are assumed to be in equilibrium with uranium-238.

Vapor Form Emissions

Vapor emissions, generated by LANSCE operations and by hot cell activities at CMR and TA-48, are sampled using a charcoal filter or canister. A continuous sample of stack air is pulled through a charcoal filter where vaporous emissions of radionuclides are adsorbed. The amount and identity of the radionuclide(s) present on the filter are determined through the use of gamma spectroscopy. This information is then used to calculate emissions. Radionuclides of this type include gallium-68, germanium-68, bromine-82, and mercury-197.

Gaseous Mixed Activation Products (GMAP)

GMAP emissions, resulting from activities at LANSCE, are measured using near real-time monitoring data. A sample of stack air is suctioned through an ionization chamber that measures the total amount of radioactivity in the sample. Specific radioisotopes are identified through the use of gamma spectroscopy and decay curves. This information is then used to calculate emissions. Radionuclides of this type include carbon-11, nitrogen-13, and oxygen-15.

Summary of Input Parameters

Effective dose equivalents to potential receptors were calculated for all radioactive air emissions from sampled LANL point sources. Input parameters for these point sources are provided in Table 3. The geographic locations of the release points, given in NM State Plane coordinates, are provided in Table 4. The relationships of receptor locations to the individual release points are provided in Table 5. The nearest receptor location is different for each point source. However, because the majority of the yearly dose has historically been caused by LANSCE emissions, the LANSCE critical receptor location has historically been the maximum dose location for all Laboratory emissions. This location is a business office approximately 800 meters north-northeast of the LANSCE stack. Emissions and doses from LANSCE are calculated on a monthly basis during beam operations to ensure continued compliance with the 10 mrem/yr. standard.

Other site-specific parameters and the sources of these data are provided in Table 6. The LANL Air Quality Group operates an on-site network of meteorological monitoring towers. Data gathered from the tower monitors are summarized and formatted for input to the CAP88 program. For 2000, data from four different towers were used for the air dispersion modeling; the tower data most representative of the release point is applied. Copies of the meteorological data files used for the 2000 dose assessment are provided in Table 7.

Table 3. 40-61.94(b)(7) User-Supplied Data—Monitored Stack Parameters

ESIDNUM	Height (m)	Diameter (m)	Exit Velocity (m/s)	Nearest Meteorological Tower
03002914	15.9	1.07	6.60	TA-6
03002915	15.9	1.05	24.35	TA-6
03002919	15.9	1.07	28.63	TA-6
03002920	15.9	1.07	6.76	TA-6
03002923	15.9	1.07	23.03	TA-6
03002924	15.9	1.06	15.52	TA-6
03002928	15.9	1.05	21.40	TA-6
03002929	15.9	1.07	22.91	TA-6
03002932	15.9	1.07	19.61	TA-6
03002933	15.9	1.06	18.83	TA-6
03002937	16.8	0.20	16.32	TA-6
03002944	16.5	1.52	11.29	TA-6
03002945	16.5	1.52	8.20	TA-6
03002946	16.5	1.88	5.30	TA-6
03010222	13.4	0.91	1.32	TA-6
16020504	18.3	0.46	21.35	TA-6
21015505	29.9	0.79	8.71	TA-53
21020901	22.9	1.22	11.39	TA-53
33008606	23.4	0.61	12.09	TA-49
41000417	30.8	1.52	2.34	TA-6
48000107	13.4	0.30	20.86	TA-6
48000154	13.1	0.91	7.07	TA-6
48000160	12.4	0.38	10.90	TA-6
50000102	15.5	1.82	13.03	TA-6
50003701	12.4	0.91	7.23	TA-6
50006903	10.5	0.31	4.60	TA-6
53000303	33.5	0.90	12.37	TA-53
53000702	13.1	0.91	9.58	TA-53
55000415	9.5	0.93	7.51	TA-6
55000416	9.5	0.94	11.38	TA-6

Table 4. 69.94(b)(7) User-Supplied Data—Monitored Stack Parameters—NM state Plane coordinates (NAD'83)

ESIDNUM	Easting	Northing
03002914	1,619,176	1,772,806
03002915	1,619,171	1,772,805
03002919	1,619,252	1,772,350
03002920	1,619,257	1,772,352
03002923	1,618,691	1,772,719
03002924	1,618,686	1,772,718
03002928	1,618,774	1,772,265
03002929	1,618,767	1,772,265
03002932	1,619,268	1,772,267
03002933	1,619,272	1,772,269
03002937	1,618,966	1,772,397
03002944	1,618,987	1,772,121
03002945	1,618,977	1,772,120
03002946	1,618,982	1,772,121
03010222	1,618,354	1,772,074
16020504	1,609,447	1,760,866
21015505	1,633,757	1,774,182
21020901	1,633,991	1,774,175
33008606	1,638,721	1,740,076
41000417	1,626,190	1,774,437
48000107	1,623,591	1,770,693
48000154	1,623,744	1,770,650
48000160	1,623,613	1,770,638
50000102	1,626,157	1,769,086
50003701	1,625,757	1,769,109
50006903	1,625,579	1,769,065
53000303	1,638,133	1,771,546
53000702	1,638,057	1,771,054
55000415	1,624,870	1,769,742
55000416	1,624,675	1,769,550

Table 5. User Supplied Data—Highest Offsite Dose Location for Monitored Release Points (meters)

ESIDNUM	Associated Meteorlogical	Distance to LANL Highest Dose Location	Direction to LANL Highest Dose Location
03002914	TA-06	5,981	E
03002915	TA-06	5,983	E
03002919	TA-06	5,969	E
03002920	TA-06	5,967	E
03002923	TA-06	6,130	E
03002924	TA-06	6,132	E
03002928	TA-06	6,116	E
03002929	TA-06	6,118	E
03002932	TA-06	5,966	E
03002933	TA-06	5,965	E
03002937	TA-06	6,054	E
03002944	TA-06	6,055	E
03002945	TA-06	6,057	E
03002946	TA-06	6,057	E
03010222	TA-06	6,249	E
16020504	TA-06	9,799	ENE
21015505	TA-53	1,525	E
21020901	TA-53	1,453	E
33008606	TA-54	10,362	N
41000417	TA-53	3,832	E
48000107	TA-06	4,730	ENE
48000154	TA-06	4,694	ENE
48000160	TA-06	4,733	ENE
50000102	TA-06	4,131	ENE
50003701	TA-06	4,242	ENE
50006903	TA-06	4,297	ENE
53000303	TA-53	800	NNE
53000702	TA-53	944	NNE
55000415	TA-53	4,434	ENE
55000416	TA-53	4,508	ENE

Table 6. 40-61.94(b)(7) User Supplied Data—Other Input Parameters

Description	Value	Units	CAP88 variable name	Reference
Annual rainfall rate	45.3	cm/y	RR	Bowen (1990)
Lid height	1525	m	LIPO	Holzworth (1972)
Annual median temp	281.9	K	TA	Bowen (1990)
E-vertical temperature gradient	0.02	K/m	TG	EPA (1995)
F-vertical temperature gradient	0.035	K/m	TG	EPA (1995)
G-vertical temperature gradient	0.035	K/m	TG	EPA (1995)
Food supply fraction - local vegetables	0.076		F1V	EPA (1989)
Food supply fraction - vegetable regional	0.924		F2V	EPA (1989)
Food supply fraction - vegetable imported	0		F3V	EPA (1989)
Food supply fraction - meat local	0.008		F1B	EPA (1989)
Food supply fraction - meat regional	0.992		F2B	EPA (1989)
Food supply fraction - meat imported	0		F3B	EPA (1989)
Food supply fraction - milk local	0		F1M	EPA (1989)
Food supply fraction - milk regional	1		F2M	EPA (1989)
Food supply fraction - milk imported	0		F3M	EPA (1989)
Ground surface roughness factor	0.5		GSCFAC	EPA (1989)

Brent M. Bowen, “Los Alamos Climatology,” Los Alamos National Laboratory report LA-11735-MS (1990).

George C. Holzworth, “Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution throughout the Contiguous United States,” U.S. Environmental Protection Agency Office of Air Programs report (1972).

U.S. Environmental Protection Agency, “User’s Guide for the Industrial Source Complex (ISC3) Dispersion Models Volume II - Description of Model Algorithms,” EPA-454/B-95-003b (1995).

U.S. Environmental Protection Agency, "Risk Assessments Methodology, Environmental Impact Statement, NESHAPS for Radionuclides, Background Information Document - Volume 1,” EPA/520/189-005 (1989).

Table 7. 40-61.94(b)(7) User Supplied Data—Wind Frequency Arrays

CAP88 Input Data for 2000 TA-6 Meteorological Tower

1	1	0.000830	.000460	.000030	.000000	.000000	.00000
1	2	0.001270	.000400	.000000	.000000	.000000	.00000
1	3	0.003030	.001570	.000000	.000000	.000000	.00000
1	4	0.005930	.003550	.000030	.000000	.000000	.00000
1	5	0.008860	.005120	.000000	.000000	.000000	.00000
1	6	0.007010	.007660	.000000	.000000	.000000	.00000
1	7	0.006390	.009010	.000000	.000000	.000000	.00000
1	8	0.004540	.008710	.000190	.000000	.000000	.00000
1	9	0.002780	.004140	.000060	.000000	.000000	.00000
1	10	0.001610	.001390	.000060	.000000	.000000	.00000
1	11	0.000960	.000710	.000000	.000000	.000000	.00000
1	12	0.000560	.001020	.000060	.000000	.000000	.00000
1	13	0.000560	.000430	.000000	.000000	.000000	.00000
1	14	0.000310	.000650	.000030	.000000	.000000	.00000
1	15	0.000280	.000520	.000120	.000000	.000000	.00000
1	16	0.000560	.000990	.000060	.000000	.000000	.00000
2	1	0.000310	.000590	.000120	.000000	.000000	.00000
2	2	0.000460	.000860	.000060	.000000	.000000	.00000
2	3	0.000740	.001510	.000030	.000000	.000000	.00000
2	4	0.001640	.002900	.000000	.000000	.000000	.00000
2	5	0.002470	.004480	.000000	.000000	.000000	.00000
2	6	0.001730	.004110	.000090	.000000	.000000	.00000
2	7	0.001330	.005060	.000090	.000000	.000000	.00000
2	8	0.001570	.007350	.000710	.000000	.000000	.00000
2	9	0.001270	.006240	.001170	.000000	.000000	.00000
2	10	0.000560	.001910	.001570	.000000	.000000	.00000
2	11	0.000120	.001080	.000930	.000030	.000000	.00000
2	12	0.000120	.000710	.000620	.000090	.000000	.00000
2	13	0.000090	.000340	.000280	.000000	.000000	.00000
2	14	0.000090	.000620	.000280	.000000	.000000	.00000
2	15	0.000090	.000900	.000710	.000000	.000000	.00000
2	16	0.000190	.000710	.000490	.000030	.000000	.00000
3	1	0.000490	.001170	.000430	.000000	.000000	.00000
3	2	0.001170	.002010	.001300	.000090	.000000	.00000
3	3	0.001450	.004110	.001390	.000060	.000000	.00000
3	4	0.002100	.005530	.000340	.000000	.000000	.00000
3	5	0.002560	.005930	.000280	.000000	.000000	.00000
3	6	0.001850	.003490	.000120	.000000	.000000	.00000

Table 7. 40-61.94(b)(7) User-Supplied Data – Wind Frequency Arrays (continued)

CAP88 Input Data for 2000 TA-6 Meteorological Tower

3	7	0.001480	.005400	.000310	.000000	.000000	.00000
3	8	0.002560	.011640	.004010	.000030	.000000	.00000
3	9	0.001940	.017840	.015030	.000190	.000000	.00000
3	10	0.000990	.010710	.010310	.000340	.000000	.00000
3	11	0.000490	.003520	.004910	.000340	.000000	.00000
3	12	0.000400	.002840	.005990	.000560	.000000	.00000
3	13	0.000190	.001910	.002930	.000280	.000000	.00000
3	14	0.000120	.001230	.002930	.000150	.000000	.00000
3	15	0.000280	.001640	.005430	.000590	.000000	.00000
3	16	0.000340	.001610	.001850	.000060	.000000	.00000
4	1	0.007500	.006950	.001230	.000250	.000000	.00000
4	2	0.007290	.008860	.004410	.000460	.000000	.00000
4	3	0.005190	.006170	.001050	.000060	.000000	.00000
4	4	0.004850	.003610	.000190	.000000	.000000	.00000
4	5	0.004410	.002220	.000150	.000000	.000000	.00000
4	6	0.003920	.001510	.000090	.000000	.000000	.00000
4	7	0.003210	.001850	.000060	.000030	.000000	.00000
4	8	0.005620	.004570	.001570	.000090	.000000	.00000
4	9	0.009570	.019110	.006270	.000430	.000000	.00000
4	10	0.008950	.030250	.008920	.001020	.000030	.00000
4	11	0.006790	.023490	.008270	.001480	.000520	.00000
4	12	0.005680	.013980	.007690	.003890	.000090	.00000
4	13	0.004540	.010220	.014910	.007930	.000650	.00000
4	14	0.003920	.009260	.018920	.012100	.002220	.00065
4	15	0.005870	.013610	.014850	.004510	.000710	.00022
4	16	0.005590	.008610	.002220	.000250	.000000	.00000
5	1	0.005090	.003830	.000000	.000000	.000000	.00000
5	2	0.003240	.002280	.000000	.000000	.000000	.00000
5	3	0.001790	.000960	.000000	.000000	.000000	.00000
5	4	0.001200	.000340	.000000	.000000	.000000	.00000
5	5	0.001700	.000060	.000000	.000000	.000000	.00000
5	6	0.001050	.000090	.000000	.000000	.000000	.00000
5	7	0.001080	.000120	.000000	.000000	.000000	.00000
5	8	0.001790	.000280	.000000	.000000	.000000	.00000
5	9	0.003520	.002190	.000000	.000000	.000000	.00000
5	10	0.005370	.006540	.000000	.000000	.000000	.00000
5	11	0.005800	.013120	.000030	.000000	.000000	.00000
5	12	0.004540	.018000	.000030	.000000	.000000	.00000
5	13	0.003490	.013340	.000740	.000000	.000000	.00000
5	14	0.002960	.006880	.002190	.000000	.000000	.00000
5	15	0.003830	.021950	.000340	.000000	.000000	.00000
5	16	0.005800	.010680	.000000	.000000	.000000	.00000
6	1	0.007100	.001820	.000000	.000000	.000000	.00000

Table 7. 40-61.94(b)(7) User-Supplied Data – Wind Frequency Arrays (continued)

CAP88 Input Data for 2000 TA-6 Meteorological Tower

6	2	0.003740	.000340	.000000	.000000	.000000	.00000
6	3	0.001790	.000120	.000000	.000000	.000000	.00000
6	4	0.001230	.000000	.000000	.000000	.000000	.00000
6	5	0.000590	.000000	.000000	.000000	.000000	.00000
6	6	0.000400	.000000	.000000	.000000	.000000	.00000
6	7	0.000560	.000030	.000000	.000000	.000000	.00000
6	8	0.001080	.000030	.000000	.000000	.000000	.00000
6	9	0.002070	.000090	.000000	.000000	.000000	.00000
6	10	0.004170	.000680	.000000	.000000	.000000	.00000
6	11	0.005930	.002070	.000000	.000000	.000000	.00000
6	12	0.007380	.009110	.000000	.000000	.000000	.00000
6	13	0.006850	.023550	.000250	.000000	.000000	.00000
6	14	0.006880	.026270	.000900	.000000	.000000	.00000
6	15	0.008300	.011850	.000000	.000000	.000000	.00000
6	16	0.007720	.004070	.000000	.000000	.000000	.00000

Table 7. 61.94(b)(7) User Supplied Data—Wind Frequency Arrays–continued

CAP88 Input Data for 2000 TA-49 Meteorological Tower

1	1	0.000320	.000110	.000000	.000000	.000000	.00000
1	2	0.001030	.000170	.000000	.000000	.000000	.00000
1	3	0.000920	.000290	.000000	.000000	.000000	.00000
1	4	0.001750	.001030	.000000	.000000	.000000	.00000
1	5	0.002670	.001890	.000000	.000000	.000000	.00000
1	6	0.002070	.002470	.000000	.000000	.000000	.00000
1	7	0.002210	.002350	.000000	.000000	.000000	.00000
1	8	0.001350	.001690	.000000	.000000	.000000	.00000
1	9	0.000980	.001090	.000000	.000000	.000000	.00000
1	10	0.000460	.000800	.000000	.000000	.000000	.00000
1	11	0.000430	.000320	.000000	.000000	.000000	.00000
1	12	0.000290	.000230	.000000	.000000	.000000	.00000
1	13	0.000260	.000140	.000000	.000000	.000000	.00000
1	14	0.000170	.000170	.000030	.000000	.000000	.00000
1	15	0.000110	.000200	.000030	.000000	.000000	.00000
1	16	0.000230	.000170	.000000	.000000	.000000	.00000
2	1	0.000060	.000090	.000000	.000000	.000000	.00000
2	2	0.000140	.000260	.000000	.000000	.000000	.00000
2	3	0.000290	.000460	.000000	.000000	.000000	.00000
2	4	0.000490	.000890	.000000	.000000	.000000	.00000
2	5	0.000890	.002270	.000000	.000000	.000000	.00000
2	6	0.000400	.002470	.000000	.000000	.000000	.00000
2	7	0.000490	.002010	.000030	.000000	.000000	.00000
2	8	0.000430	.001520	.000000	.000000	.000000	.00000
2	9	0.000170	.001460	.000000	.000000	.000000	.00000
2	10	0.000170	.000720	.000000	.000000	.000000	.00000
2	11	0.000030	.000490	.000030	.000000	.000000	.00000
2	12	0.000060	.000400	.000000	.000000	.000000	.00000
2	13	0.000140	.000260	.000060	.000000	.000000	.00000
2	14	0.000030	.000370	.000060	.000000	.000000	.00000
2	15	0.000060	.000060	.000000	.000000	.000000	.00000
2	16	0.000060	.000110	.000000	.000000	.000000	.00000
3	1	0.000170	.000260	.000030	.000000	.000000	.00000
3	2	0.000260	.000490	.000110	.000000	.000000	.00000
3	3	0.000230	.001180	.000090	.000000	.000000	.00000
3	4	0.000720	.002870	.000060	.000000	.000000	.00000
3	5	0.000770	.006480	.000060	.000000	.000000	.00000
3	6	0.000660	.005140	.000090	.000000	.000000	.00000
3	7	0.000490	.004560	.000260	.000000	.000000	.00000

Table 7. 40-61.94(b)(7) User Supplied Data—Wind Frequency Arrays (continued)

CAP88 Input Data for 2000 TA-49 Meteorological Tower

3	9	0.000400	.005570	.000920	.000000	.000000	.00000
3	10	0.000430	.001950	.000720	.000000	.000000	.00000
3	11	0.000320	.000860	.000230	.000000	.000000	.00000
3	12	0.000140	.000660	.000490	.000000	.000000	.00000
3	13	0.000090	.000720	.001000	.000200	.000000	.00000
3	14	0.000060	.000830	.001690	.000110	.000000	.00000
3	15	0.000090	.000340	.000230	.000000	.000000	.00000
3	16	0.000140	.000370	.000090	.000000	.000000	.00000
4	1	0.004050	.007520	.004020	.002150	.000060	.00000
4	2	0.004020	.009040	.004330	.002270	.000090	.00000
4	3	0.003500	.011990	.005940	.000690	.000140	.00000
4	4	0.003530	.010760	.004190	.000260	.000030	.00000
4	5	0.002350	.008520	.002350	.000060	.000000	.00000
4	6	0.001980	.005390	.001610	.000260	.000030	.00000
4	7	0.002150	.005570	.002300	.000400	.000140	.00000
4	8	0.002350	.008350	.008840	.002930	.000170	.00003
4	9	0.003440	.024390	.049320	.026190	.000980	.00000
4	10	0.004050	.020080	.029580	.013400	.000980	.00014
4	11	0.002900	.011070	.014890	.007860	.001690	.00029
4	12	0.002750	.008490	.011220	.008090	.002410	.00032
4	13	0.002380	.009210	.014520	.008920	.001430	.00003
4	14	0.002470	.008290	.016070	.009640	.000980	.00020
4	15	0.003440	.006940	.009900	.007750	.000830	.00017
4	16	0.002810	.008180	.006340	.003930	.000690	.00003
5	1	0.002700	.011500	.006110	.000000	.000000	.00000
5	2	0.002730	.006020	.001920	.000000	.000000	.00000
5	3	0.001920	.003360	.000860	.000000	.000000	.00000
5	4	0.001690	.001150	.000320	.000000	.000000	.00000
5	5	0.001350	.000950	.000030	.000000	.000000	.00000
5	6	0.000920	.000920	.000090	.000000	.000000	.00000
5	7	0.000950	.000660	.000110	.000000	.000000	.00000
5	8	0.001090	.001380	.000720	.000000	.000000	.00000
5	9	0.001720	.007030	.003240	.000000	.000000	.00000
5	10	0.002900	.017820	.004500	.000000	.000000	.00000
5	11	0.002270	.018850	.008000	.000000	.000000	.00000
5	12	0.002180	.010930	.005050	.000000	.000000	.00000
5	13	0.001920	.008750	.003100	.000000	.000000	.00000
5	14	0.002440	.009750	.008350	.000000	.000000	.00000
5	15	0.002500	.010700	.005340	.000000	.000000	.00000
5	16	0.002900	.008090	.002780	.000000	.000000	.00000
6	1	0.005140	.011560	.001950	.000000	.000000	.00000
6	2	0.004330	.001780	.000090	.000000	.000000	.00000
6	3	0.002380	.000340	.000030	.000000	.000000	.00000

Table 7. 40-61.94(b)(7) User Supplied Data—Wind Frequency Arrays (continued)

CAP88 Input Data for 2000 TA-49 Meteorological Tower

6	4	0.001380	.000060	.000000	.000000	.000000	.00000
6	5	0.001030	.000140	.000000	.000000	.000000	.00000
6	6	0.000860	.000170	.000000	.000000	.000000	.00000
6	7	0.001180	.000260	.000030	.000000	.000000	.00000
6	8	0.001150	.000630	.000060	.000000	.000000	.00000
6	9	0.001920	.002180	.000140	.000000	.000000	.00000
6	10	0.002440	.004850	.000340	.000000	.000000	.00000
6	11	0.003440	.009320	.000770	.000000	.000000	.00000
6	12	0.003900	.016980	.002500	.000000	.000000	.00000
6	13	0.002520	.022260	.006770	.000000	.000000	.00000
6	14	0.003070	.013970	.007890	.000000	.000000	.00000
6	15	0.004390	.012190	.004050	.000000	.000000	.00000
6	16	0.005080	.021750	.011130	.000000	.000000	.00000

Table 7. 40-61.94(b)(7) User Supplied Data—Wind Frequency Arrays (continued)

CAP88 Input Data for 2000 TA-53 Meteorological Tower

1	1	0.000900	.000320	.000000	.000000	.000000	.00000
1	2	0.002050	.000400	.000000	.000000	.000000	.00000
1	3	0.004570	.001420	.000000	.000000	.000000	.00000
1	4	0.005760	.004170	.000000	.000000	.000000	.00000
1	5	0.005410	.005350	.000000	.000000	.000000	.00000
1	6	0.003560	.004830	.000000	.000000	.000000	.00000
1	7	0.003010	.002980	.000030	.000000	.000000	.00000
1	8	0.002810	.002340	.000030	.000000	.000000	.00000
1	9	0.001620	.001360	.000000	.000000	.000000	.00000
1	10	0.000720	.000780	.000000	.000000	.000000	.00000
1	11	0.000580	.000430	.000000	.000000	.000000	.00000
1	12	0.000320	.000380	.000000	.000000	.000000	.00000
1	13	0.000290	.000320	.000030	.000000	.000000	.00000
1	14	0.000520	.000380	.000000	.000000	.000000	.00000
1	15	0.000380	.000460	.000090	.000000	.000000	.00000
1	16	0.000520	.000320	.000000	.000000	.000000	.00000
2	1	0.000140	.000120	.000000	.000000	.000000	.00000
2	2	0.000430	.000460	.000000	.000000	.000000	.00000
2	3	0.001210	.001300	.000000	.000000	.000000	.00000
2	4	0.001420	.003530	.000000	.000000	.000000	.00000
2	5	0.001010	.004510	.000000	.000000	.000000	.00000
2	6	0.000670	.003960	.000000	.000000	.000000	.00000
2	7	0.000670	.002660	.000000	.000000	.000000	.00000
2	8	0.000610	.002050	.000000	.000000	.000000	.00000
2	9	0.000550	.001300	.000000	.000000	.000000	.00000
2	10	0.000200	.000750	.000030	.000000	.000000	.00000
2	11	0.000090	.000520	.000000	.000000	.000000	.00000
2	12	0.000030	.000400	.000030	.000000	.000000	.00000
2	13	0.000030	.000400	.000060	.000000	.000000	.00000
2	14	0.000140	.000290	.000170	.000000	.000000	.00000
2	15	0.000120	.000400	.000090	.000000	.000000	.00000
2	16	0.000140	.000140	.000000	.000000	.000000	.00000
3	1	0.000200	.000430	.000170	.000000	.000000	.00000
3	2	0.000870	.001100	.000350	.000000	.000000	.00000
3	3	0.001590	.003180	.000400	.000000	.000000	.00000
3	4	0.001790	.006880	.000200	.000000	.000000	.00000
3	5	0.000950	.007690	.000290	.000000	.000000	.00000
3	6	0.000640	.005730	.000320	.000000	.000000	.00000
3	7	0.000780	.004830	.000030	.000000	.000000	.00000

Table 7. 40-61.94(b)(7) User Supplied Data—Wind Frequency Arrays (continued)

CAP88 Input Data for 2000 TA-53 Meteorological Tower

3	8	0.000780	.005610	.000230	.000000	.000000	.00000
3	9	0.000720	.005180	.000950	.000000	.000000	.00000
3	10	0.000430	.002370	.000380	.000000	.000000	.00000
3	11	0.000170	.001100	.000460	.000030	.000000	.00000
3	12	0.000090	.001190	.000550	.000000	.000000	.00000
3	13	0.000200	.001300	.001420	.000030	.000000	.00000
3	14	0.000120	.000720	.001620	.000000	.000000	.00000
3	15	0.000140	.000400	.000840	.000030	.000000	.00000
3	16	0.000230	.000350	.000170	.000000	.000000	.00000
4	1	0.007290	.007900	.005840	.003070	.000460	.00000
4	2	0.006680	.009520	.006190	.002550	.000290	.00000
4	3	0.005580	.009890	.003270	.000430	.000030	.00000
4	4	0.004980	.009520	.001710	.000060	.000000	.00000
4	5	0.003820	.006600	.000950	.000000	.000000	.00000
4	6	0.003470	.005120	.000930	.000170	.000000	.00000
4	7	0.003010	.005060	.001680	.000200	.000000	.00000
4	8	0.003470	.011690	.008850	.002690	.000430	.00003
4	9	0.003910	.020830	.035030	.009200	.000140	.00000
4	10	0.004050	.020450	.038790	.014030	.000780	.00012
4	11	0.002690	.014960	.019790	.009340	.001240	.00035
4	12	0.002780	.008560	.014120	.007170	.001620	.00000
4	13	0.003270	.009230	.017360	.005350	.001130	.00003
4	14	0.003240	.008040	.014000	.005700	.000610	.00012
4	15	0.003410	.005580	.007230	.004450	.000720	.00014
4	16	0.005440	.004800	.004570	.002080	.000550	.00003
5	1	0.005640	.009920	.002600	.000000	.000000	.00000
5	2	0.004430	.006510	.002170	.000000	.000000	.00000
5	3	0.003500	.003070	.001010	.000000	.000000	.00000
5	4	0.002340	.001760	.000140	.000000	.000000	.00000
5	5	0.002430	.001420	.000000	.000000	.000000	.00000
5	6	0.001760	.000840	.000060	.000000	.000000	.00000
5	7	0.001620	.001330	.000030	.000000	.000000	.00000
5	8	0.001530	.002080	.000400	.000000	.000000	.00000
5	9	0.001710	.007380	.003040	.000000	.000000	.00000
5	10	0.002080	.021260	.018340	.000000	.000000	.00000
5	11	0.002490	.025950	.013940	.000000	.000000	.00000
5	12	0.002780	.015910	.013650	.000000	.000000	.00000
5	13	0.002660	.013390	.009690	.000000	.000000	.00000
5	14	0.003210	.009370	.003070	.000000	.000000	.00000
5	15	0.003620	.005870	.002720	.000000	.000000	.00000
5	16	0.004600	.008970	.002370	.000000	.000000	.00000
6	1	0.003960	.001530	.000140	.000000	.000000	.00000
6	2	0.004920	.001650	.000030	.000000	.000000	.00000

Table 7. 40-61.94(b)(7) User Supplied Data—Wind Frequency Arrays (continued)

CAP88 Input Data for 2000 TA-53 Meteorological Tower

6	3	0.003500	.001070	.000000	.000000	.000000	.00000
6	4	0.003360	.000930	.000000	.000000	.000000	.00000
6	5	0.003440	.000230	.000000	.000000	.000000	.00000
6	6	0.003210	.000290	.000000	.000000	.000000	.00000
6	7	0.003010	.000750	.000000	.000000	.000000	.00000
6	8	0.003210	.001270	.000000	.000000	.000000	.00000
6	9	0.003930	.003410	.000000	.000000	.000000	.00000
6	10	0.004600	.005440	.000140	.000000	.000000	.00000
6	11	0.003960	.003880	.000120	.000000	.000000	.00000
6	12	0.003040	.006390	.001040	.000000	.000000	.00000
6	13	0.003100	.008130	.002080	.000000	.000000	.00000
6	14	0.003070	.006250	.000290	.000000	.000000	.00000
6	15	0.004340	.002720	.000000	.000000	.000000	.00000
6	16	0.003730	.002290	.000030	.000000	.000000	.00000

Table 7. 40-61.94(b)(7) User Supplied Data—Wind Frequency Arrays (continued)

CAP88 Input Data for 2000 TA-54 Meteorological Tower

1	1	0.000600	.000170	.000000	.000000	.000000	.00000
1	2	0.001180	.000860	.000000	.000000	.000000	.00000
1	3	0.002210	.002520	.000000	.000000	.000000	.00000
1	4	0.005500	.005530	.000000	.000000	.000000	.00000
1	5	0.009230	.010520	.000000	.000000	.000000	.00000
1	6	0.008660	.008400	.000000	.000000	.000000	.00000
1	7	0.005880	.005130	.000000	.000000	.000000	.00000
1	8	0.003700	.004240	.000000	.000000	.000000	.00000
1	9	0.002210	.002750	.000000	.000000	.000000	.00000
1	10	0.001090	.002150	.000090	.000000	.000000	.00000
1	11	0.000860	.000460	.000000	.000000	.000000	.00000
1	12	0.000460	.000570	.000030	.000000	.000000	.00000
1	13	0.000370	.000320	.000000	.000000	.000000	.00000
1	14	0.000260	.000230	.000000	.000000	.000000	.00000
1	15	0.000230	.000170	.000030	.000000	.000000	.00000
1	16	0.000290	.000260	.000000	.000000	.000000	.00000
2	1	0.000090	.000060	.000000	.000000	.000000	.00000
2	2	0.000230	.000430	.000000	.000000	.000000	.00000
2	3	0.000800	.002440	.000000	.000000	.000000	.00000
2	4	0.000950	.004160	.000170	.000000	.000000	.00000
2	5	0.000660	.003350	.000200	.000030	.000000	.00000
2	6	0.000630	.002210	.000170	.000030	.000000	.00000
2	7	0.000600	.001890	.000000	.000000	.000000	.00000
2	8	0.000720	.002030	.000000	.000000	.000000	.00000
2	9	0.000290	.002610	.000110	.000000	.000000	.00000
2	10	0.000140	.002010	.000030	.000000	.000000	.00000
2	11	0.000110	.000370	.000000	.000000	.000000	.00000
2	12	0.000110	.000460	.000030	.000000	.000000	.00000
2	13	0.000030	.000490	.000090	.000000	.000000	.00000
2	14	0.000110	.000200	.000110	.000000	.000000	.00000
2	15	0.000110	.000110	.000030	.000000	.000000	.00000
2	16	0.000110	.000170	.000030	.000000	.000000	.00000
3	1	0.000140	.000540	.000030	.000000	.000000	.00000
3	2	0.000370	.002090	.000260	.000000	.000000	.00000
3	3	0.000830	.006880	.000720	.000000	.000000	.00000
3	4	0.001290	.005620	.001030	.000000	.000000	.00000
3	5	0.000890	.002090	.000340	.000000	.000000	.00000
3	6	0.000490	.001200	.000140	.000030	.000000	.00000

Table 7. 61.94(b)(7) User-Supplied Data – Wind Frequency Arrays (continued)

CAP88 Input Data for 2000 TA-54 Meteorological Tower

3	7	0.000400	.001830	.000200	.000000	.000000	.00000
3	8	0.000720	.003810	.000630	.000000	.000000	.00000
3	9	0.000630	.006680	.002440	.000000	.000000	.00000
3	10	0.000570	.005070	.001830	.000000	.000000	.00000
3	11	0.000320	.001920	.000570	.000000	.000000	.00000
3	12	0.000260	.000660	.001490	.000060	.000000	.00000
3	13	0.000110	.001180	.003350	.000200	.000000	.00000
3	14	0.000200	.000890	.004010	.000340	.000000	.00000
3	15	0.000230	.000260	.000690	.000000	.000000	.00000
3	16	0.000090	.000260	.000140	.000000	.000000	.00000
4	1	0.006420	.005070	.003270	.002780	.000140	.00000
4	2	0.006130	.010460	.006510	.002210	.000320	.00000
4	3	0.004470	.014850	.005760	.000370	.000030	.00000
4	4	0.003900	.005040	.000830	.000090	.000000	.00000
4	5	0.002120	.001230	.000060	.000000	.000000	.00000
4	6	0.002690	.000690	.000030	.000090	.000000	.00000
4	7	0.002120	.001660	.000690	.000140	.000000	.00000
4	8	0.001400	.003070	.003980	.002810	.000140	.00000
4	9	0.002780	.010370	.024390	.009630	.000200	.00000
4	10	0.002810	.022560	.051730	.019660	.000800	.00003
4	11	0.003980	.014700	.020060	.009030	.000970	.00046
4	12	0.003580	.009940	.009770	.005160	.001150	.00000
4	13	0.004670	.008170	.008600	.003380	.000320	.00000
4	14	0.005620	.006910	.009540	.002150	.000260	.00000
4	15	0.005420	.007310	.007850	.002550	.000060	.00000
4	16	0.005960	.005730	.003840	.001430	.000110	.00000
5	1	0.006190	.007370	.001230	.000000	.000000	.00000
5	2	0.003700	.004160	.002030	.000000	.000000	.00000
5	3	0.002290	.002240	.000400	.000000	.000000	.00000
5	4	0.001430	.001200	.000000	.000000	.000000	.00000
5	5	0.000830	.000200	.000000	.000000	.000000	.00000
5	6	0.000570	.000090	.000000	.000000	.000000	.00000
5	7	0.000570	.000320	.000000	.000000	.000000	.00000
5	8	0.001090	.000540	.000000	.000000	.000000	.00000
5	9	0.001150	.002550	.000430	.000000	.000000	.00000
5	10	0.001810	.010320	.007340	.000000	.000000	.00000
5	11	0.002030	.014930	.013530	.000000	.000000	.00000
5	12	0.003210	.010920	.001780	.000000	.000000	.00000
5	13	0.004900	.016140	.001200	.000000	.000000	.00000
5	14	0.008170	.017940	.000400	.000000	.000000	.00000
5	15	0.009140	.026880	.000370	.000000	.000000	.00000
5	16	0.009490	.011580	.000770	.000000	.000000	.00000
6	1	0.004840	.007620	.000170	.000000	.000000	.00000

Table 7. 61.94(b)(7) User-Supplied Data – Wind Frequency Arrays (continued)

CAP88 Input Data for 2000 TA-54 Meteorological Tower

6	2	0.003500	.003470	.000110	.000000	.000000	.00000
6	3	0.002120	.001030	.000000	.000000	.000000	.00000
6	4	0.000720	.000060	.000000	.000000	.000000	.00000
6	5	0.000230	.000000	.000000	.000000	.000000	.00000
6	6	0.000090	.000000	.000000	.000000	.000000	.00000
6	7	0.000200	.000030	.000000	.000000	.000000	.00000
6	8	0.000400	.000090	.000000	.000000	.000000	.00000
6	9	0.000520	.000690	.000060	.000000	.000000	.00000
6	10	0.001460	.004380	.000290	.000000	.000000	.00000
6	11	0.002150	.011780	.001600	.000000	.000000	.00000
6	12	0.003440	.021240	.002980	.000000	.000000	.00000
6	13	0.007570	.025450	.001400	.000000	.000000	.00000
6	14	0.010950	.015080	.000000	.000000	.000000	.00000
6	15	0.009200	.024130	.000200	.000000	.000000	.00000
6	16	0.004960	.011980	.001290	.000000	.000000	.00000

The Air Quality Group also inputs population array data to the CAP88 program. The data file represents a 16-sector polar-type array, with 20 radial distances for each sector. Population arrays are developed for each release point using U.S. Census data, updated with annual projections. An example of the population array used for the LANSCE facility is provided in Table 8. For agricultural array input, LANL is currently using the default values in CAP88. Finally, the radionuclide inputs for the point sources monitored in 2000 are provided in Table 9.

Public Receptors

Compliance with the annual dose standard is determined by calculating the highest effective dose equivalent to any member of the public at any off-site point where there is a residence, school, business, or office. Late in the calendar year, a visual tour of the laboratory vicinity was completed to identify new locations inhabited by the public; that is, new off-site public receptors that had not existed in the year previous to this assessment. Some new businesses and residences were noted in the 2000 tour. In this report, the nearest off-site point is defined to be the area of public inhabitation where the highest off-site dose occurs for a given emissions source. For the 2000 compliance assessment, LANL-wide doses were evaluated at the nearest off-site point for each monitored emissions stack, as well as at a number of additional key locations.

Point Source Emissions Modeling

The CAP88 program was used to calculate doses from both the monitored and unmonitored point sources at LANL. The CAP88 program uses on-site meteorological data to calculate atmospheric dispersion and transport of the radioactive effluents. There are a number of radionuclides monitored in LANL effluents that are not included in the dose factor database used by CAP88.[8] For the substantial GMAP effluents such as ^{10}C, ^{16}N, and ^{14}O, LANL uses a revised set of CAP88 database files to which the required dose factors have been added. For other effluents such as ^{68}Ga, ^{68}Ge, ^{82}Br, ^{197}Hg, etc., LANL uses the CAP88 code to calculate environmental concentrations of these radionuclides at the receptor locations and then applies an appropriate dose factor to estimate dose.

LANSCE Fugitive Emission Modeling

Some of the gaseous mixed activation products (GMAP) created at the accelerator target cells migrate into room air and into the environment. These fugitive sources are continuously monitored throughout the beam-operating period. In 2000, approximately 140 Ci of ^{11}C and 6 Ci of ^{41}Ar were released from LANSCE as fugitive emissions. This source was modeled as an area source, using CAP88 and meteorological data coinciding with the LANSCE run cycle. Fugitive effluents were modeled from two areas at LANSCE; additional source information is provided in Table 10.

TA-18 Nonpoint Emission Modeling

This site consists of a variety of nuclear assemblies that are operated at near-critical conditions. During the near-critical operations, neutrons are generated that, in turn, activate argon atoms in the air surrounding the assembly. Operations conducted in 2000 were evaluated for their potential to create ^{41}Ar gas. In 2000, approximately 0.8 Ci of ^{41}Ar was generated,

Table 8. 40-61.94(b)(7) User-Supplied Data – Population Array

Projected 1999-2000 Population within 80 km of Los Alamos National Laboratory

	Distance from TA53 (km)															
Direction	**0.8-1.0**	**1.0-1.5**	**1.5-2.0**	**2.0-2.5**	**2.5-3.0**	**3.0-3.5**	**3.5-4.0**	**4.0-5.0**	**5.0-6.0**	**6.0-7.0**	**7.0-8.0**	**8.0-10**	**10-20**	**20-30**	**30-40**	**40-80**
N	6	17	55	26	51	80	92	137	0	0	0	0	17	107	1113	1647
NNW	5	16	47	227	166	88	254	274	20	0	0	0	8	23	306	546
NW	5	11	20	56	315	379	205	669	409	388	52	0	2	28	58	1194
WNW	0	6	9	15	67	207	808	1034	1843	2581	714	0	0	29	34	2888
W	0	0	3	8	13	17	94	161	16	0	0	0	8	71	321	156
WSW	0	8	10	10	7	6	3	0	0	0	0	1	8	40	444	2622
SW	0	9	4	0	0	0	0	0	0	0	1	3	3	0	0	2643
SSW	0	5	0	0	0	0	0	0	0	0	0	32	3	944	1410	65977
S	0	5	0	0	0	0	0	0	0	0	0	18	6	18	164	3695
SSE	0	6	0	0	0	0	0	0	0	331	216	308	52	320	5829	2805
SE	0	2	0	0	0	0	0	0	0	1527	3266	556	0	1064	75112	8463
ESE	0	0	0	0	0	1	0	0	0	0	0	10	12	723	8286	3094
E	0	0	0	0	0	0	0	0	0	0	1	0	1769	4215	410	546
ENE	1	0	0	0	0	0	0	0	0	0	0	0	2327	4805	4104	3332
NE	4	9	2	0	0	0	0	0	0	0	0	0	1441	16913	2988	6898
NNE	6	17	51	7	37	31	24	23	0	0	0	0	16	2791	458	1139

Table 9. 40-61.94(b)(7) User-Supplied Data—Radionuclide Emissions

ESID Number	Nuclide	Emissions (Ci)
03002914	Pu-238	3.02E-09
03002915	Pu-239	5.02E-08
03002915	Am-241	2.61E-08
03002919	Pu-239	5.87E-07
03002919	Pu-238	1.26E-06
03002919	Am-241	7.80E-08
03002920	Pu-239	7.54E-08
03002920	Pu-238	1.13E-08
03002920	Am-241	3.27E-08
03002923	U-238	1.74E-07
03002923	U-235	1.28E-07
03002923	U-234	3.72E-06
03002923	Th-234	1.74E-07
03002923	Th-231	1.28E-07
03002923	Pu-239	1.14E-08
03002923	Pu-238	7.34E-09
03002923	Pa-234m	1.74E-07
03002923	Am-241	6.62E-09
03002924	U-234	2.72E-06
03002924	Th-228	1.26E-07
03002924	Pu-239	1.37E-08
03002924	Pu-238	9.93E-08
03002924	Am-241	1.50E-08
03002928	Pu-239	1.52E-07
03002928	Pu-238	9.57E-07
03002928	Am-241	2.65E-08
03002929	Pu-238	4.94E-09
03002932	None Detected	None
03002933	None Detected	None
03002937	None Detected	None
03002944	None Detected	None
03002945	None Detected	None
03002946	Pu-239	1.75E-08

Table 9. 40-61.94(b)(7) User-Supplied Data–Radionuclide Emissions (continued)

ESIDNUM	Nuclide	Emissions (Ci)
03010222	U-238	1.32E-09
03010222	U-235	1.91E-09
03010222	U-234	5.33E-08
03010222	Th-234	1.32E-09
03010222	Th-231	1.91E-09
03010222	Th-230	1.18E-09
03010222	Pa-234m	1.32E-09
16020504	H-3(HTO)	2.18E+02
16020504	H-3(Gas)	3.90E+01
21015505	H-3(HTO)	1.51E+02
21015505	H-3(Gas)	2.46E+01
21020901	H-3(HTO)	5.13E+02
21020901	H-3(Gas)	2.50E+02
33008606	H-3(HTO)	1.01E+03
33008606	H-3(Gas)	1.47E+02
41000417	H-3(HTO)	5.60E+00
41000417	H-3(Gas)	6.62E-01
48000107	Se-75	1.36E-04
48000107	Ge-68	8.14E-03
48000107	Ga-68	8.14E-03
48000107	Br-77	2.82E-05
48000107	As-74	2.79E-05
48000107	As-73	4.37E-05
48000154	None Detected	None
48000160	Se-75	5.33E-06
48000160	Ge-68	8.07E-06
48000160	Ga-68	8.07E-06
50000102	Th-230	5.27E-08
50000102	Pu-238	9.78E-09
50003701	None Detected	None
50006903	None Detected	None
53000303	H-3(HTO)	5.99E-01
53000303	C-11	8.32E+00
53000303	C-10	8.68E-01
53000303	Ar-41	1.01E-01

Table 9. 40-61.94(b)(7) User-Supplied Data—Radionuclide Emissions (continued)

ESIDNUM	Nuclide	Emissions (Ci)
53000702	O-15	9.11E+01
53000702	O-14	4.06E-01
53000702	N-16	1.70E-02
53000702	N-13	2.77E+01
53000702	Hg-197	1.04E-01
53000702	Hg-195m	2.01E-02
53000702	Hg-193	8.02E-01
53000702	H-3(HTO)	2.32E+00
53000702	C-11	5.40E+02
53000702	C-10	1.44E-01
53000702	Br-82	4.19E-03
53000702	Br-76	2.59E-04
53000702	As-73	2.21E-05
53000702	Ar-41	2.30E+01
55000415	Pu-239	9.52E-08
55000415	Pu-238	4.69E-09
55000416	Pu-239	2.30E-06
55000416	Pu-238	1.01E-07
55000416	H-3(HTO)	3.11E-01
55000416	H-3(Gas)	6.14E+00
55000416	Am-241	3.30E-07

Table 10. 40-61.94(b)(7) User-Supplied Data—Modeling Parameters for LANL Nonpoint Sources

LANL Air Activation Sources

Source	Radionuclide	Emission (Ci)	Area of source (m^2)	Distance to LANL Maximum Dose Location (m)	Direction to LANL Maximum Dose Location
TA-53-Switchyard	Ar-41	0.8	484	774	NNE
	C-11	19.8	484	774	NNE
TA-53-1L Service Area	Ar-41	4.9	1.0	943	NNE
	C-11	117.9	1.0	943	NNE
TA-18	Ar-41	0.8	31,400	3,894	NNE

and the dose was evaluated with CAP88. Additional source information is provided in Table 10.

Radionuclides Not Included in CAP88

Some of the radionuclides detected in LANL air effluents are not included in the CAP88 library of exposure-to-dose conversion factors. As previously mentioned, LANL added dose coefficients to the CAP88 data files for three routinely emitted radionuclides: ^{10}C, ^{16}N, and ^{14}O. Because of the unique emissions from LANSCE and other facilities, other radionuclides not included in CAP88 are emitted on an infrequent basis. Examples of such radionuclides detected in LANL air effluents during 2000 are included in Table 9 and are listed separately in Table 11.

To calculate the dose from these particular radionuclides, LANL uses several methods. LANL uses the mainframe version of CAP88 to calculate the air concentration at the receptor location of interest. In most cases, the air concentration can then be converted into a dose by applying the conversions given in Table 2 of Appendix E of 40 CFR 61, which has a more extensive list of radionuclides than CAP88.[9] In some cases, LANL obtains exposure-to-dose conversion factors from other sources, such as EPA's Federal Guidance Reports.[10,11] Dose conversion factors used for radionuclides not included in CAP88 but found in LANL air effluents during 2000 are provided in Table 12.

At the LANL-wide maximum dose location for 2000, the total estimated dose arising from emissions of radionuclides not included in the CAP88 library was about 0.01 mrem. This number is included in the total annual dose. The LANL Air Quality Group has informed the Regional Office of

Table 11. 40-61.94(b)(7) User-Supplied Data—Radionuclide Not Included in CAP88

Source	ESIDNUM	Radionuclide	Emissions (Ci)	Dose at LANL Receptor (mrem)	Dose at Facility Receptor (mrem)
TA-48-1-7	48000107	As-73	4.37E-05	3.55E-07	4.27E-06
		As-74	2.79E-05	1.14E-06	1.36E-05
		Br-77	2.82E-05	5.95E-08	7.14E-07
		Ga-68	8.14E-03	8.02E-07	9.67E-06
		Ge-68	8.14E-03	3.65E-03	4.40E-02
		Se-75	1.36E-04	7.06E-05	8.82E-04
TA48-1-60	48000160	Ga-68	8.07E-06	8.02E-10	1.03E-08
		Ge-68	8.07E-06	3.65E-06	4.70E-05
		Se-75	5.33E-06	2.82E-06	3.65E-05
TA-53-7-2	53000702	As-73	2.21E-05	1.82E-06	1.82E-06
		Br-76	2.59E-04	1.87E-06	1.87E-06
		C-10	1.44E-01	7.26E-06	7.26E-06
		Hg-193	8.02E-01	6.31E-04	6.31E-04
		Hg-195m	2.01E-02	1.87E-04	1.87E-04
		Hg-197	1.04E-01	1.12E-03	1.12E-03
		N-16	1.70E-02	1.43E-12	1.43E-12
		O-14	4.06E-01	6.06E-03	6.06E-03

the U.S. EPA of the various steps and methods used to calculate the doses from such radionuclides.[12]

Environmental Data

The net annual average ambient concentration of airborne radionuclides measured at 19 air sampling stations (Figure 3) is calculated by subtracting an appropriate background concentration value. In CY 2000 two new station locations were added to the network; these were station #66 at the Los Alamos Inn, and #67 at the TA-3 Research Park. Station 66 is a replacement for Station #7, Shell Station. In late 1999/early 2000 a three-story apartment building was constructed directly south and within 25 meters of Station #7. The apartment building prevents Station #7 from having an unrestricted airflow from the Laboratory to the station. A replacement location was selected, Station #66, approximately 250 m to the southeast, on the edge of Los Alamos canyon. This location maintains the spatial coverage provided by station #7 for Laboratory diffuse emissions. Station #66 began operation in April 2000.

Table 12. 40-61.94(b)(7) User-Supplied Data—Supplemental Dose Factors

Radionuclide	Ci per m3 per 10 mrem	Reference
As-73	1.10E-11	EPA (1989)
As-74	2.20E-12	EPA (1989)
Br-76	1.23E-10	LANL (2000)
Br-77	4.20E-11	EPA (1989)
C-10	1.13E-11	DOE (1998)
Ga-68	9.10E-10	LANL (2000)
Ge-68	2.00E-13	LANL (2000)
Hg-193	2.96E-09	LANL (2001)
Hg-195m	2.20E-10	LANL (2001)
Hg-197	8.30E-11	EPA (1989)
N-16	3.43E-12	DOE (1998)
O-14	5.29E-12	DOE (1998)
Se-75	1.70E-13	EPA (1989)

U.S. Environmental Protection Agency, "National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities," Code of Federal Regulations, Title 40, Part 61.90, Table 2 of Appendix E to Subpart H (1989).

Department of Energy, letter to Mr. George P. Brozowski, U.S. Environmental Protection Agency Region 6 from Mr. Steve Fong, DOE Los Alamos Area Office, Aug 18, 1998.

Los Alamos National Laboratory, internal memo to Mr. Dave Fuehne from Keith W. Jacobson, Air Quality Group memo ESH17:01-250, May 22, 2001.

Station #7 was operated for the entire calendar year 2000 and then was discontinued. Results from both stations are provided in this report.

A new, nonDOE facility was constructed during CY2000, the Los Alamos Research Park. This facility is on DOE property, but employs members of the public. Thus, this became a potential new MEI receptor location, requiring monitoring. No existing AIRNET station was located near this facility, and so a new station was installed and began operating during July 2000.

The net concentration at each air sampler is converted to an annual effective dose equivalent (EDE) using Table 2 of Appendix E of 40 CFR 61 and applying the valid assumption that each table value is equivalent to 10 mrem/yr. from all appropriate exposure pathways (100% occupancy assumed at the respective location).[9] Results from each air sampler are given in Table 13. The operational performance of each air sampler is provided in Table 14.

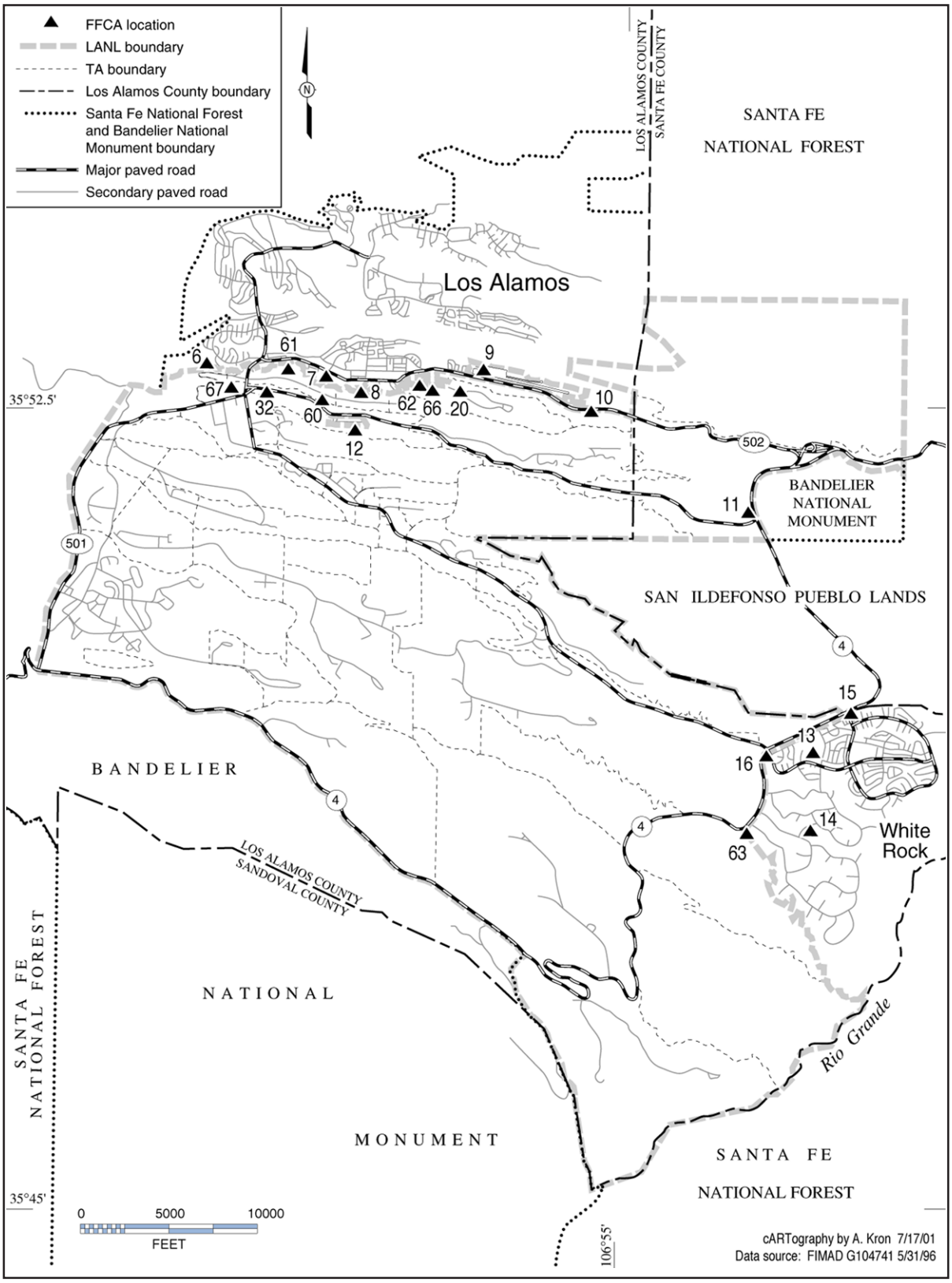

Figure 3. Locations of air sampling stations used for nonpoint source compliance

LANSCE Monthly Assessments

The Air Quality group evaluates the dose from short-lived radioactive gases released from LANSCE on a monthly basis. The monthly dose values are evaluated with the actual meteorology for the month and these doses are given in Table 15. The Air Quality group also evaluates the annual LANSCE emissions with annual average meteorology, and compares the results to the monthly values summed for the calendar year; the values for these two assessments were 0.25 mrem and 0.27 mrem respectively.

Highest EDE Determination

A major change to the procedure for determining the highest EDE was necessary for CY 1999 because of significantly reduced emissions from the LANSCE facility. Over the previous nine years, the off-site effective dose equivalent due to LANSCE operations had averaged about 5 mrem. For 1999, the highest off-site EDE from the LANSCE facility was about 0.01 mrem. The highest off-site EDE location for LANSCE effluents is a business office in the East Gate area (2470 East Gate Drive). Since the contribution from LANSCE for 1999 was greatly reduced, the location of the highest off-site dose was not as readily established as it had been in the past.

In late 1999, LANL began working on a plan to ensure that the location of the highest public dose could be determined. This plan uses a multistep approach, and the steps used were presented to the local Citizens' Advisory Board (CAB) for LANL for their review and comment. This approach was approved by the CAB for CY 1999 and was used again for the CY 2000 dose assessment determination. Table 16 shows the sites identified by LANL for the purposes of finding the location of the highest off-site dose. Also shown in the table is the AIRNET sampling station that the Air Quality Group associated with the selected public receptor location. The LANL-wide doses at these various off-site locations are provided in Table 16. The highest off-site dose location was determined to be the East Gate area, because of increased emissions from LANSCE in 2000, as compared to 1999.

61.92: Compliance Assessment

The highest effective dose equivalent to any member of the public at any off-site point where there is a residence, school, or business office was 0.64 mrem for radionuclides released by LANL in 2000. This dose was calculated by adding up the doses for each of the point sources at LANL, the diffuse and fugitive gaseous activation products from LANSCE and TA-18, and the dose measured by the ambient air sampler in the vicinity of the public receptor location. The compliance assessment also includes a potential dose contribution of 0.18 mrem from unmonitored stacks. Because the emissions estimates do not account for pollution control systems, the actual dose will be significantly less for the unmonitored point sources. Also, this dose includes an approximate 0.01 mrem contribution from radionuclides not included in CAP88. Table 17 provides the compliance assessment summary. The location of the off-site point of highest EDE for 2000 was a business office at 2470 East Gate Drive; this location is different from the location of the previous year's assessments. The 1999 highest off-site EDE location was a business office at the Los Alamos County landfill; Table 17 also lists the LANL-wide doses at this location, for comparison.

Table 13. FFCA and Air Sampler Environmental Data

2000 Effective Dose Equivalent (net in mrem) at Air Sampling Locations Around LANL

Site # and Name		Am-241	H-3	Pu-238	Pu-239	U-234	U-235	U-238	Rounded Total
06	48th Street	-0.003	0.003	0.001	0.000	0.000	0.000	0.003	0.00
07	Shell Station	0.004	0.007	-0.001	0.027	0.049	0.005	0.059	0.15
08	McDonalds	0.000	0.012	-0.001	0.005	0.008	0.001	0.009	0.03
09	Los Alamos Airport	0.002	0.033	0.001	0.009	0.005	0.002	0.007	0.06
10	Eastgate	0.002	0.026	0.001	0.003	0.009	0.000	0.013	0.05
11	Well PM-1 (E. Jemez Rd.)	-0.001	0.010	-0.002	0.001	0.001	0.000	0.005	0.02
12	Royal Crest Trailer Court	0.000	0.011	0.002	0.004	0.009	0.002	0.010	0.04
13	Rocket Park	-0.002	0.016	0.001	0.000	0.003	0.001	0.000	0.02
14	Pajarito Acres	-0.002	0.012	0.001	-0.001	0.000	0.000	0.003	0.01
15	White Rock Fire Station	-0.001	0.011	0.001	0.006	0.003	0.000	0.005	0.02
16	White Rock Nazarene Church	0.002	0.024	0.001	-0.001	0.003	0.000	0.004	0.03
20	TA-21 Area B	0.002	0.029	0.000	0.027	0.019	0.002	0.023	0.10
32	County Landfill (TA-48)	0.008	0.010	0.002	0.023	0.074	0.004	0.072	0.19
60	LA Canyon	0.001	0.007	0.000	0.001	0.005	0.001	0.008	0.02
61	LA Hospital	0.004	0.005	0.000	0.002	0.011	0.000	0.015	0.04
62	Crossroads Bible Church	0.005	0.015	0.001	0.003	0.004	0.001	0.006	0.03
63	Monte Rey South	-0.003	0.012	0.001	-0.001	0.002	0.001	0.005	0.02
66	Los Alamos Inn – South*	0.000	0.012	0.002	0.084	0.007	0.002	0.014	0.12
67	TA-3 Research Park*	-0.002	0.004	0.000	-0.003	0.045	0.003	0.031	0.08

* New stations added in 2000.

Table 14. FFCA Analytical Completeness Summary—Air Sampler Operation

Site #	Site Name	% Run Time	Analysis	% Analytical Completeness
06	48th Street	98.6		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
07	Shell Station	96.8		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
08	McDonalds	100.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
09	Los Alamos Airport	100.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0

Table 14. FFCA Analytical Completeness Summary—Air Sampler Operation (continued)

Site #	Site Name	% Run Time	Analysis	% Analytical Completeness
10	Eastgate	99.3		
			Am-241	100.0
			H-3	108.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
11	Well PM-1 (E. Jemez Road)	100.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
12	Royal Crest Trailer Court	100.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
13	Rocket Park	100.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0

Table 14. FFCA Analytical Completeness Summary—Air Sampler Operation (continued)

Site #	Site Name	% Run Time	Analysis	% Analytical Completeness
14	Pajarito Acres	100.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
15	White Rock Fire Station	98.9		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
16	White Rock Nazarene Church	99.3		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
20	TA-21 Area B	97.6		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0

Table 14. FFCA Analytical Completeness Summary—Air Sampler Operation (continued)

Site #	Site Name	% Run Time	Analysis	% Analytical Completeness
32	County Landfill (TA-48)	100.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
60	LA Canyon	100.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
61	LA Hospital	100.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
62	Crossroads Bible Church	98.2		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0

Table 14. FFCA Analytical Completeness Summary—Air Sampler Operation (continued)

Site #	Site Name	% Run Time	Analysis	% Analytical Completeness
63	Monte Rey South	100.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
66	Los Alamos Inn – South*	100.0		
			Am-241	75.0
			H-3	68.0
			Pu-238	75.0
			Pu-239	75.0
			U-234	75.0
			U-235	75.0
			U-238	75.0
67	TA-3 Research Park†	100.0		
			Am-241	50.0
			H-3	32.0
			Pu-238	50.0
			Pu-239	50.0
			U-234	50.0
			U-235	50.0
			U-238	50.0

***This station began operation in April 2000.**
†This station began operation in August 2000.

Table 15. LANSCE Monthly Assessments and Summary

Description	ESIDNUM	Dose at East Gate Receptor
LANSCE-stack-January	53000303	6.85E-05
LANSCE-stack-February	53000303	1.98E-04
LANSCE-stack-March	53000303	4.54E-05
LANSCE-stack-April	53000303	3.21E-04
LANSCE stack-May	53000303	1.23E-07
LANSCE stack-June	53000303	6.34E-05
LANSCE stack-July	53000303	1.14E-04
LANSCE stack-August	53000303	1.96E-04
LANSCE stack-September	53000303	2.66E-04
LANSCE-stack-October	53000303	9.05E-05
LANSCE-stack-November	53000303	1.60E-04
LANSCE-stack-December	53000303	4.45E-05
LANSCE-stack-PVAP*	53000303	2.98E-05
LANSCE-Non-CAP88 Radionuclides*	53000303	0.00E+00
LANSCE-stack-January	53000702	1.27E-03
LANSCE-stack-February	53000702	7.97E-04
LANSCE-stack-March	53000702	3.16E-04
LANSCE-stack-April	53000702	1.83E-02
LANSCE stack-May	53000702	3.78E-03
LANSCE stack-June	53000702	1.21E-02
LANSCE stack-July	53000702	9.48E-03
LANSCE stack-August	53000702	2.94E-02
LANSCE stack-September	53000702	4.07E-02
LANSCE-stack-October	53000702	6.84E-02
LANSCE-stack-November	53000702	3.62E-02
LANSCE-stack-December	53000702	5.19E-02
LANSCE-stack-PVAP*	53000702	2.75E-04
LANSCE-Non-CAP88 Radionuclides*	53000702	8.01E-03
LANSCE-Fugitive Emissions - Switchyard*	530003sy	1.74E-02
LANSCE-Fugitive Emissions - 1L Area*	5300071L	7.01E-02
LANSCE Summary		**3.70E-01**

Table 16. 40-61.92 Effective Dose Equivalent at Selected Public Locations

	Location	Easting	Northing	Nearest AIRNET Location	AIRNET Number	LANL-Wide EDE (mrem)*
1	Barranca School	1,630,910	1,783,870	Barranca School†	04	5.41E-02
2	Residence Near Urban Park	1,618,400	1,780,000	Urban Park†	05	2.94E-02
3	Residence on Fairway Drive	1,618,602	1,776,052	48th Street	06	1.36E-02
4	Los Alamos Shell	1,623,892	1,775,889	Shell Station	07	1.62E-01
5	Los Alamos McDonald's	1,626,450	1,775,350	LA McDonald's	08	5.13E-02
6	Los Alamos Airport	1,632,902	1,776,247	Los Alamos Airport	09	1.15E-01
7	Tsankawi Visitor Center	1,648,105	1,758,380	Well PM-1	11	4.54E-02
8	Royal Crest Trailer Court - West	1,624,256	1,773,065	Royal Crest Tlr. Crt.	12	5.14E-02
9	Royal Crest Trailer Court - East	1,625,778	1,772,955	Royal Crest Trl. Crt.	12	5.38E-02
10	Residence near WR Rocket Park	1,651,950	1,755,300	Rocket Park	13	3.72E-02
11	Residence in Pajarito Acres	1,650,770	1,750,520	Pajarito Acres	14	2.84E-02
12	White Rock Fire Station	1,653,580	1,756,630	WR Fire Station	15	3.83E-02
13	Bandelier Fire Lookout	1,635,700	1,739,005	Bandelier†	17	6.68E-02
14	Residence on Nambe Loop	1,621,568	1,776,046	TA-21 Area B	20	8.52E-02
15	Ponderosa Campground	1,608,575	1,758,460	TA-49†	26	4.21E-02
16	County Landfill Office	1,620,569	1,774,763	County Landfill	32	2.02E-01
17	Los Alamos Ice Rink	1,617,852	1,775,692	LA Canyon	60	3.18E-02
18	Los Alamos Hospital	1,620,200	1,776,300	LA Hospital	61	4.79E-02
19	Cross Roads Bible Church	1,629,200	1,776,000	Cross. Bible Church	62	5.49E-02
20	Residence on Monte Rey South	1,647,976	1,750,376	Monte Rey South	63	3.53E-02
21	Los Alamos Inn	1,624,450	1,775,300	Los Alamos Inn-S	66	1.34E-01
22	Research Park	1,618,300	1,774,600	TA-3 Research Park	67	8.84E-02
23	2470 East Gate (NNE sector)	1,638,825	1,774,097	East Gate	10	4.59E-01
24	Residence at East Gate (N sector)	1,638,616	1,774,231	East Gate	10	3.61E-01
25	Business at East Gate (NE sector)	1,640,230	1,774,090	East Gate	10	2.87E-01

* Note, to allow for more meaningful comparisons, these doses do not include the estimated contribution from unmonitored point sources.
†Note, these samplers are not part of the regular NESHAPs compliance network for LANL.

Table 17. 61.92 Highest Effective Dose Equivalent Summary

ESIDNUM	Description	Dose for Release Site Receptor	Dose at Landfill Receptor	Dose at East Gate Receptor
03002914	CMR Stack	6.90E-07	6.90E-07	5.46E-08
03002915	CMR Stack	1.32E-05	1.32E-05	1.51E-06
03002919	CMR Stack	2.64E-04	2.64E-04	2.93E-05
03002920	CMR Stack	3.20E-05	3.20E-05	2.68E-06
03002923	CMR Stack	2.10E-04	2.10E-04	2.53E-05
03002924	CMR Stack	3.94E-04	3.94E-04	2.23E-05
03002928	CMR Stack	1.38E-04	1.38E-04	1.79E-05
03002929	CMR Stack	5.62E-07	5.62E-07	7.44E-08
03002932	CMR Stack	0.00E+00	0.00E+00	0.00E+00
03002933	CMR Stack	0.00E+00	0.00E+00	0.00E+00
03002937	CMR Stack	0.00E+00	0.00E+00	0.00E+00
03002944	CMR Stack	0.00E+00	0.00E+00	0.00E+00
03002945	CMR Stack	0.00E+00	0.00E+00	0.00E+00
03002946	CMR Stack	3.23E-06	3.23E-06	3.25E-07
03010222	Shops Addition Stack	4.83E-06	4.83E-06	4.29E-07
16020504	WETF Stack	1.22E-02	2.20E-03	1.27E-03
18000001	TA-18 Diffuse	4.61E-05	2.46E-06	4.61E-05
21015505	TSTA Stack	6.43E-03	9.38E-04	4.35E-03
21020901	TSFF Stack	3.06E-02	3.84E-03	2.21E-02
33008606	HP-Site Stack	2.71E-02	1.56E-03	3.48E-03
41000417	W-Site Stack	2.29E-04	8.79E-05	6.19E-05
48000107	Radiochemistry Stack/non-CAP88 radionuclides	4.49E-02	3.98E-03	3.72E-03
48000154	Radiochemsitry Stack	0.00E+00	0.00E+00	0.00E+00
48000160	Radiochemistry Stack/non CAP88 radionuclides	8.35E-05	7.12E-06	6.47E-06
50000102	Waste Management Stack	4.71E-06	4.81E-07	1.14E-06
50003701	Waste Management Stack	0.00E+00	0.00E+00	0.00E+00
50006903	Waste Management Stack	0.00E+00	0.00E+00	0.00E+00
53000303	LANSCE-Stack-Annual	1.60E-03	1.58E-05	1.60E-03
53000303	LANSCE-Stack/non CAP88 radionuclides	0.00E+00	0.00E+00	0.00E+00
53000399	LANSCE Fugitive Emissions	8.75E-02	2.63E-04	8.75E-02
53000702	LANSCE-Stack-Annual	2.73E-01	1.04E-03	2.73E-01
53000702	LANSCE-Stack/non CAP88 radionuclides	8.01E-03	4.52E-05	8.01E-03
55000415	Plutonium Facility Stack	2.10E-05	1.74E-06	2.74E-06
55000416	Plutonium Facility Stack	1.01E-03	1.04E-04	1.66E-04
99000000	Unmonited Stacks-gross	1.80E-01	1.80E-01	1.80E-01
99000010	Air-Sampler Net Dose	1.91E-02	1.91E-01	5.40E-02
	Total	**6.93E-01**	**3.86E-01**	**6.39E-01**